Mechanical Requirement and Influence on the Design and Manufacturing of Transverse Stripline Kicker of Taiwan Photon Source (TPS)

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Theme: Transverse stripline kicker, Monitor, Impedance matching

Abstract:
The use of transverse stripline kickers is essential to new 3rd generation synchrotron light sources. They act as one of the major correction mechanism for electron beams to compensate things like the mismatch in four injection kickers etc. Since how much power is actually needed is difficult to assess beforehand, more unit just needs to be installed when there is not enough power to correct the electron beam. It is essential to make sure the power efficiency to reach electron beam to be as high as possible. Hence the characteristic impedance matching on the power transmission route is critical in both design and manufacturing phase. The goal is to design and manufacture 500 watts transverse stripline kicker with independent x and y directions. Time domain reflectometry (TDR) method is essential to verify the design and manufacturing accuracy and identify if there is any issue in these processes. All related simulation data is presented in this paper.

1-Requirement of stripline kicker

The major purpose of stripline kicker is to compensate the deviation of electron trace generated by the mismatch of four injection kickers and the accuracy of vacuum system manufacturing and installation. In theory, they are all perfect. But in reality, they all have engineering limits. This is where the stripline kicker can contribute. Traditionally, stripline kicker was made with feedthroughs and electrodes. There was no special consideration on characteristic impedance matching on the whole structure. Most of the time, the x and y direction were combined in one transverse stripline kicker due to space shortage. The power efficiency of such design is only 2/3 of separate design. The length of kicker electrode is half wavelength. Hence, we adopt independent x- and y- direction transverse stripline kicker with 300mm long electrode.

2- The importance of characteristic impedance match

It is important to have the whole electrical structure to be impedance matched to have the kicking power to be transferred efficiently. Otherwise the power will be reflected before it reach the electrode and nearby electrons. It is also important to reduce the impedance generated by the kicker structure. Hence we have adopted ground planes in both vertical and horizontal stripline kickers.

3- The simulation of vertical stripline kicker

We have just started the simulation of the vertical stripline kicker. The following figures are engineering drawings and drawings for HFSS simulation. This simulation work is ongoing.

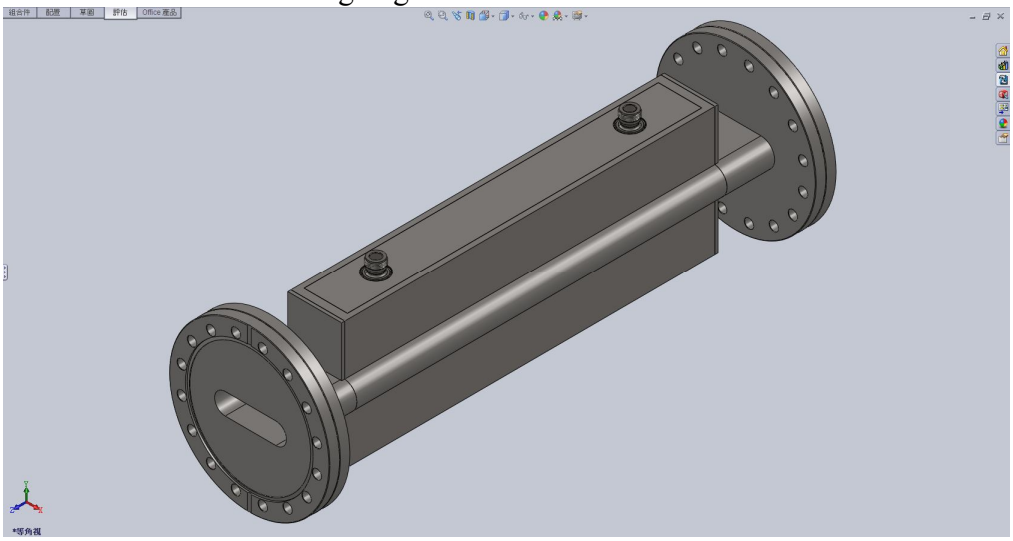

Fig. 1 First draft of engineering drawing of vertical stripline kicker.

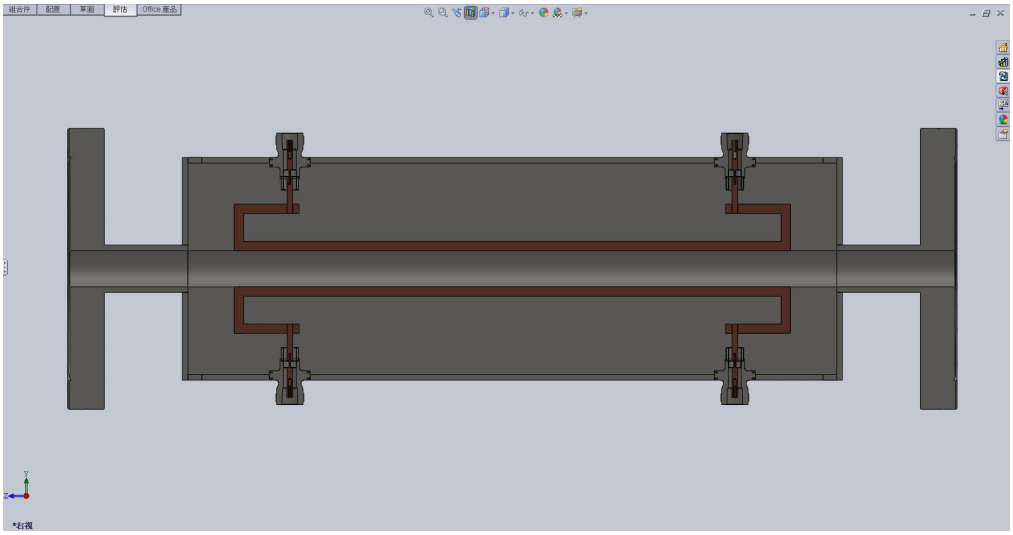

Fig.2 Side view of internal structure of vertical stripline kicker.

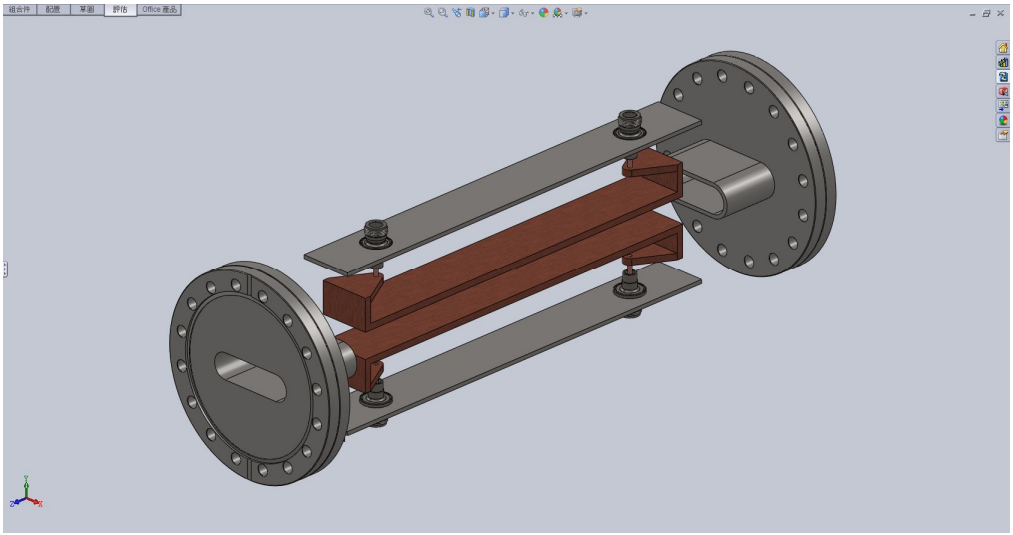

Fig.3 Internal structure of vertical stripline kicker with vacuum chamber hided.

In order to accelerate the simulation process, complicated components like flanges and N-type connector structure are either omitted or simplified. With both end flanges existing in the simulation, it will take about three days to get one barely converged result. With extended beam pipe as in Figure 5, converged results can be generated in less than four hours. And the convergence is much better also (0.021 once after 15 passes to 0.018 twice after 7 passes).

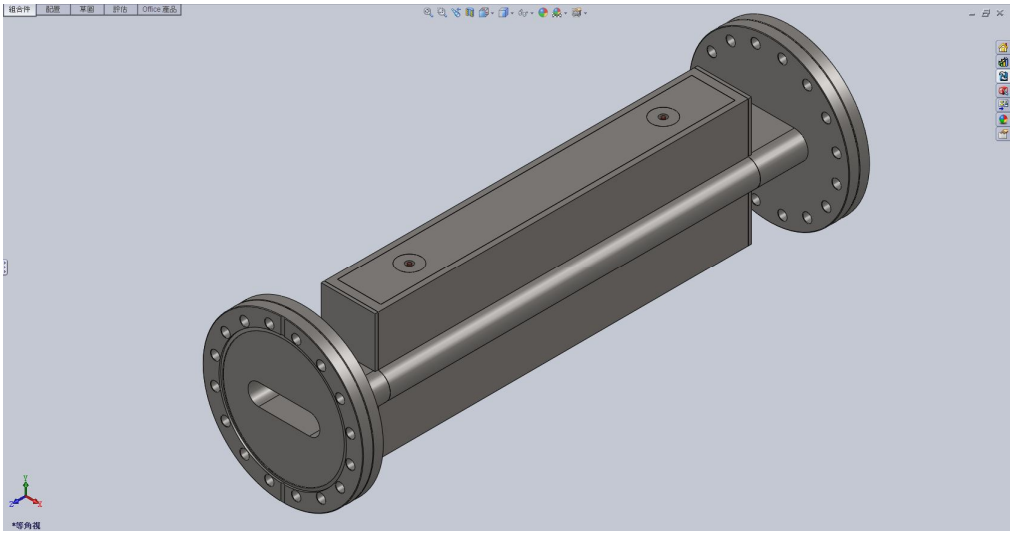

Figure 4 First version simplified design for HFSS simulation. Only N-type connector was simplified.

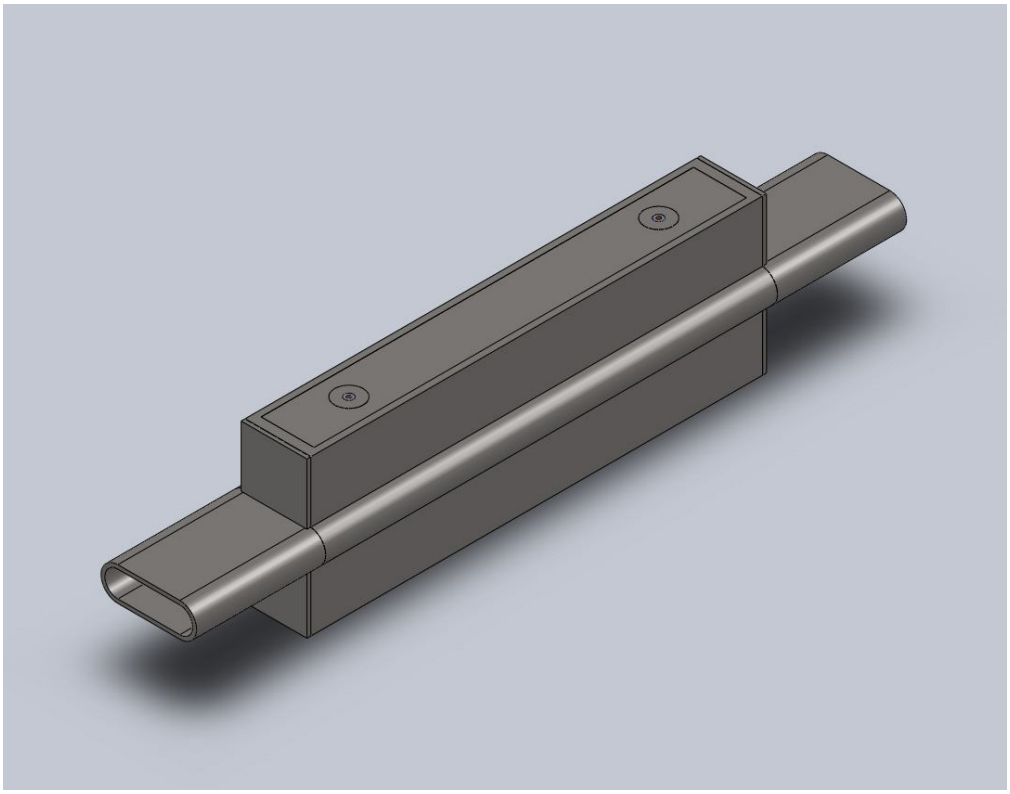

Figure 5 Second version simplified design for HFSS simulation. Both flanges were replaced by extended beam duct.

4- Simulation results

The electrode length has been verified to match beam RF frequency. The following results has been verified and further simulation and manufacturing are ongoing.

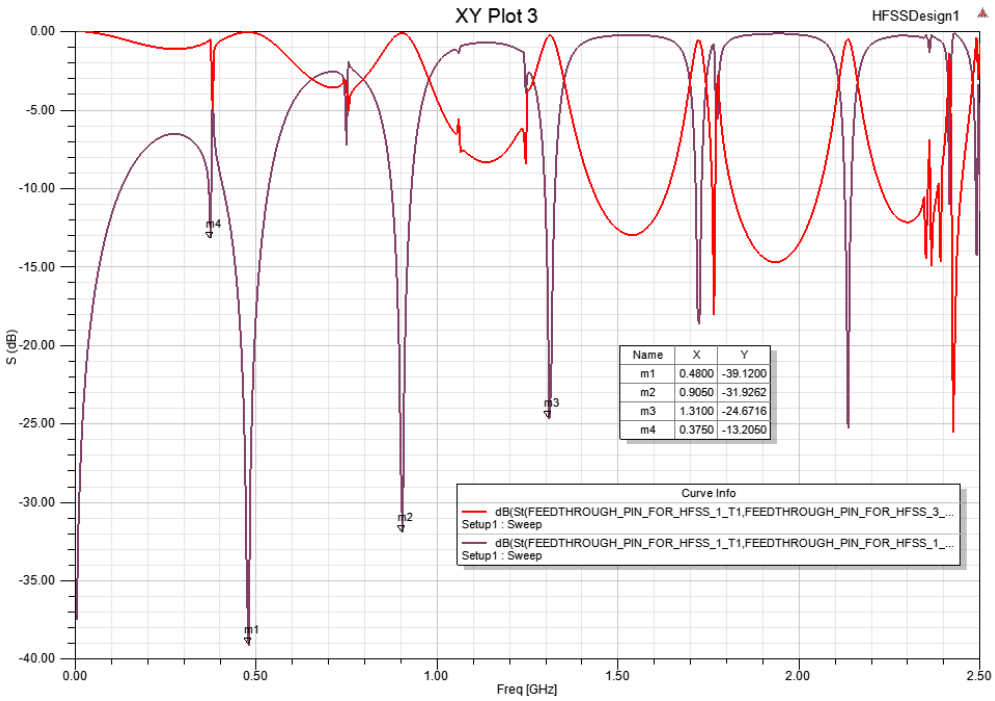

Figure 6 The 300mm long electrode has 480MHz resonance frequency in the current design.

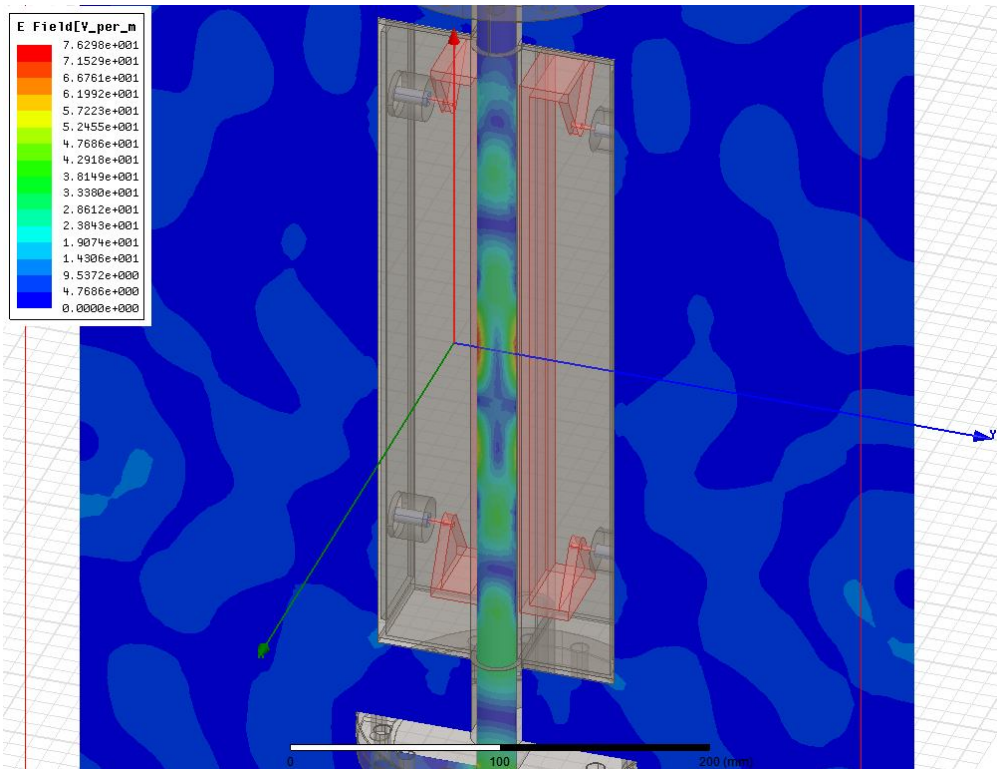

Figure 7 The electrical field distribution in 300mm ling electrode design.

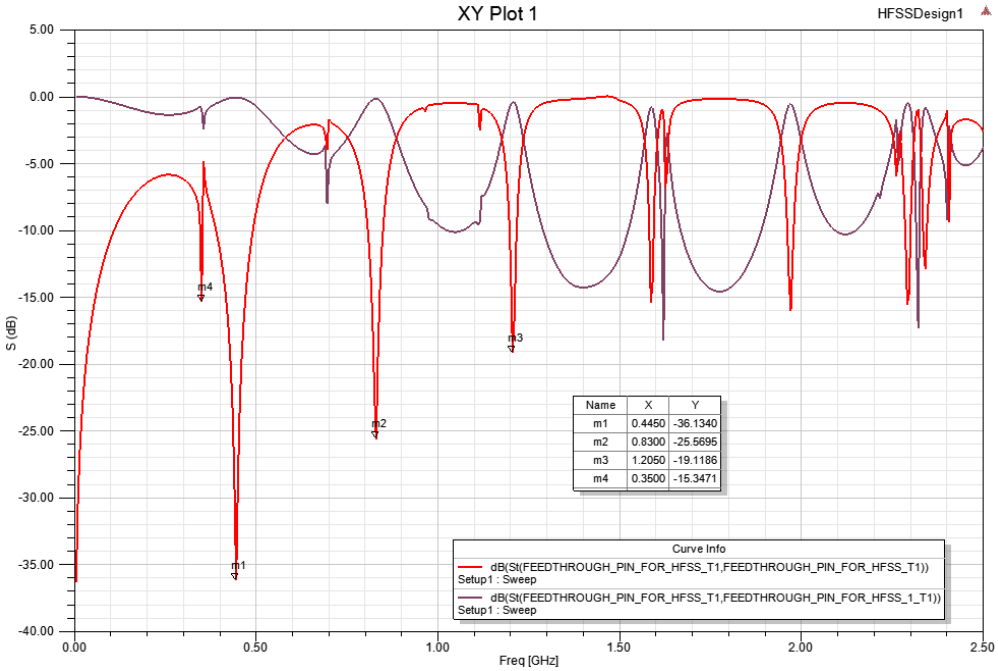

Figure 8 The 320mm long electrode has 445MHz resonance frequency in second deign as expected.

References

[1] TPS Design Report, unpublished.

[2] T. Nakamura, JASRI/SPring-8, discussion and stripline kicker design.

[3] HFSS, ver. 14.0 and ver. 15.0.

[4] M. Dehler, V. Schlott, D. Bulfone, M. Lonza, and R. Ursic ,Current status of the ELETTRA/SLS transverse multibunch feedback, Proceedings of EPAC'00

[5] U. Iriso, T.F. Gunzel, and F. Perez, Design of The Stripline and Kickers for ALBA, Proceedings of DIPAC09 (2009) 86-88